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## PATENT SPECIFICATION

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### DRAWINGS ATTACHED

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### (54) LEVEL CONTROL SYSTEMS FOR THE WHEEL SUSPENSIONS OF VEHICLES

(71) I, VIKTOR LANGEN, a German citizen trading as LANGEN & CO., of Klosterstrasse 49, 4 Dusseldorf, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a level control system for the wheel suspensions of a vehicle, particularly a motor vehicle, comprising level regulating elements between the sprung and unsprung parts of the vehicle and a level control valve associated with each regulating element, said level control valve connecting the regulating element according to the relative positions of the sprung and unsprung parts in a first position of control to a pressure pipe, in a second position of control to a return pipe and in a third position of control cutting off these connections, a pressure limiting valve being interposed between the pressure pipe and the return pipe or reservoir for protecting the circuit from overloads

Although such level control systems have been known in the art for some time (for example in the published specification of West German Patent Appln No. 1 057 467) they have not found favour in practice. Besides the drawback of a higher price and a higher consumption of pressure fluid their unsatisfactory stabilising effects have led to preference being given to the so-called three-point control. Whereas the position of a vehicle body is statically exactly determined by three-point control it is over-determined in a four-point system of control which calls for very accurate matching of all four regulating elements. If this requirement is not fulfilled the vehicle body may behave like a table with four legs of which one is shorter than the other, so that the table wobbles on one of the diagonals. This kind of wobble can also occur when one wheel of the vehicle happens to stand in a depression or a hole in the road.

[Price 25p]

It is therefore the object of the present invention to improve the stability of a vehicle provided with a level control of the first hereinabove specified kind without introducing additional complications.

According to the invention this is achieved by so matching the areas of the effective faces of the level regulating elements and the pressure to which the pressure limiting valve 18 is adjusted that, at the maximum permissible all-up weight of the vehicle, level control is only possible when all the level regulating elements are evenly loaded.

The invention is particularly suitable for vehicles in which the ratio of the permissible all-up weight to its unladen weight does not exceed 1.4 to 1.5. In the case of such vehicles level control is possible when the regulating elements are evenly loaded when the vehicle is empty or fully loaded. However, the level control fails when only three or two regulating elements are loaded because the pressure generated in the regulators exceeds the pressure to which the pressure limiting valve has been set. The vehicle body will then sink until the other regulating elements also share in the load and the vehicle assumes a stable position. The invention is suitable for pneumatic or hydro-pneumatic springs and for mechanical spring suspensions supported on regulating elements. In a particularly advantageous manner regulators may be used that are fitted with internal level control means and in the case of which three-point control is impossible.

The drawing schematically illustrates an arrangement according to the invention. A vehicle not shown in detail is provided with wheels  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_4$  attached to control arms  $L_1$ ,  $L_2$ ,  $L_3$  and  $L_4$ . The control arms are supported from the vehicle frame by hydro-pneumatic suspension units  $F_1$ ,  $F_2$ ,  $F_3$  and  $F_4$ . The suspension units  $F_1$ ,  $F_2$ ,  $F_3$  and  $F_4$  contain working chambers  $A_1$ ,  $A_2$ ,  $A_3$  and  $A_4$  connected by pipe means  $B_1$ ,  $B_2$ ,  $B_3$  and  $B_4$  to

level control valves  $N_1, N_2, N_3$  and  $N_4$  which are controlled by rods  $G_1, G_2, G_3, G_4$  by reference to the distance existing between the control arms  $L_1, L_2, L_3$  and  $L_4$  and the vehicle frame and which in a first position of control connect the pipes  $B_1, B_2, B_3$  and  $B_4$  to pressure pipes  $P_1, P_2, P_3$  and  $P_4$ , in a second position of control to exhaust or return pipes  $T_1, T_2, T_3$  and  $T_4$  and in a third position of control shut off communication between all these pipes. The pressure pipes  $P_1, P_2, P_3$  and  $P_4$  are branch pipes from a main pressure pipe  $P$  from a pressure source  $D$ , such as a pump. The pressure pipe is associated with a pressure limiting valve  $V$  which establishes a return connection to a reservoir  $S$  when overloads occur. The return pipes  $T_1, T_2, T_3$  and  $T_4$  join in a common return pipe  $T$  likewise leading to the reservoir. The effective working faces of the hydro-pneumatic suspension units are marked  $f_1, f_2, f_3$  and  $f_4$ .

The invention is naturally not restricted in scope to the schematically illustrated embodiment. For instance, the wheel suspension as such may be different. The regulating elements need not be hydro-pneumatic suspension units. They could also have the form of compressed air bellows. Finally, the type and operation of the level control valves is arbitrary and possible arrangements include the location of the level control means inside the regulating elements themselves.

#### WHAT I CLAIM IS:—

1. A level control system for the wheel suspensions of a vehicle, particularly a

motor vehicle, comprising level regulating elements interposed between the sprung and unsprung parts of the vehicle and a level control valve associated with each regulating element, said level control valve connecting the regulating element, according to the relative positions of the sprung and unsprung parts, in a first position of control to a pressure pipe, in a second position of control to a return pipe and in a third position of control shutting off these connections, and a pressure-limiting valve interposed between the pressure pipe and the return pipe or a reservoir for protecting the circuit from overloads, characterised in that the areas of the effective faces of the regulating elements and the pressure to which the pressure-limiting valve is adjusted are so matched that, at the maximum permissible all-up weight of the vehicle, level control is only possible when all the level regulating elements are evenly loaded.

2. A level control system as claimed in claim 1, wherein the ratio of the maximum permissible all-up weight of the vehicle at which level control is possible to the unladen weight of the vehicle is less than 1.5.

3. A level control system as claimed in claim 1 or 2, wherein the level regulating elements are hydro-pneumatic springs.

4. A level control system substantially as hereinbefore described with reference to the accompanying drawing.

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COMPLETE SPECIFICATION

1 SHEET

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